

### Examiner's Amendment

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.
2. Authorization for this examiner's amendment was given in a telephone interview with **Attorney Paul Teng Reg. No. 40,837** on **September 19, 2008** along with authorization to charge any necessary fees to applicant's deposit account.
3. The application has been amended as follows:

**A) Replace claim 1** of the **June 20, 2008** amendment and response with the following **Examiner amended claim 1**:

**Claim 1** ---A magnetic resonance imaging apparatus **configured** for imaging a selected portion of a subject placed in a static magnetic field, said magnetic resonance imaging apparatus comprising RF transmitting means for applying an RF excitation pulse to said subject an RF irradiation control means for controlling irradiation phase of the RF excitation pulse, RF receiving means for detecting nuclear magnetic resonance signals generated from the subject, a control means for controlling the RF transmitting means, the RF irradiation control means and the RF receiving means, and an image formation means for reconstructing an image of said selected portion of the subject by using the nuclear magnetic resonance signals,

said RF transmitting means including a first coil and one or more additional coils,

wherein the RF irradiation control means controls RF irradiation so that the RF excitation pulse is simultaneously applied to each of said first **RF excitation** coil and said one or more additional **RF excitation** coils such that **within a single simultaneously applied RF excitation**, a phase of a second half of a waveform of an **RF excitation** output of at least one of **said first coil and** said one or more additional

**RF excitation** coils, after the temporal center of the **simultaneously applied** RF excitation pulse, is **maintained to be held** different by **180°** from a phase of the first half of the pulse waveform, **of the RF excitation output**, such that **the RF** excitation is selectively applied only to a local region **of the selected portion of the subject**. ---

**B) Replace claim 2 of the June 20, 2008 amendment and response with the following Examiner amended claim 2:**

**Claim 2** --- The magnetic resonance imaging apparatus according to claim 1, wherein the RF transmitting means is provided with a multiple array RF transmitting coil comprising multiple RF **excitation** coils of different sensitivity profiles, and the RF irradiation control means performs such phase control for a part of the multiple RF **excitation** coils that the phase of the second half of the RF pulse waveform after the temporal center thereof, **is maintained continuously** different by 180° from the phase of the first half of the RF **excitation** pulse waveform. ---

**C) Insert claim 3 of the June 20, 2008 amendment and response:**

**Claim 3** ---The magnetic resonance imaging apparatus according to **claim 2**, wherein the multiple array RF transmitting coil is provided with a RF loop coil and at least one RF differential coil, the RF differential coil is provided with multiple RF subloop coils, the multiple RF subloop coils and the RF loop coil have a common central axis, the RF subloop coils are plane-symmetrically disposed around the RF loop coil as the center, and the RF subloop coils constituting the same RF differential coil are connected so that currents should flow through a pair of plane-symmetrically disposed RF subloop coils in different directions. ---

**D) Replace claim 4** of the **June 20, 2008** amendment and response with the following **Examiner amended claim 4**:

**Claim 4** --- The magnetic resonance imaging apparatus according to **claim 3**, wherein the RF differential coil is provided with a primary RF differential coil and a secondary RF differential coil, the RF subloop coils of the primary RF differential coil are disposed so that the RF loop coil **is located** between the RF subloop coils of the primary RF differential coil, and the RF subloop coils of the secondary RF differential coil are disposed so that the RF loop coil and the RF subloop coils of the primary RF differential coil **are located** between the RF subloop coils of the secondary RF differential coil. ---

**E) Insert claims 5 and 6** of the **June 20, 2008** amendment and response:

**Claim 5** --- The magnetic resonance imaging apparatus according to **claim 2**, wherein the RF transmitting means is provided with, as RF transmitting coils, a first multiple array RF transmitting coil comprising a first RF loop coil and at least one RF differential coil having a common central axis and a second multiple array RF transmitting coil comprising a second RF loop coil and at least one RF differential coil having a common central axis, and the central axes of the first and second multiple array RF transmitting coil are perpendicular to each other. ---

**Claim 6** --- The magnetic resonance imaging apparatus according to **claim 3**, wherein the RF loop coil comprises plane-symmetrically disposed multiple RF loop coils. ---

**F) Replace claims 7 through 10 of the June 20, 2008 amendment and response with the following Examiner amended claims 7-10:**

**Claim 7** --- The magnetic resonance imaging apparatus according to **claim 3**, wherein the RF irradiation control means performs such phase control for the RF differential coil among the multiple RF **excitation** coils that the phase of the second half of the RF **excitation** pulse waveform after the temporal center thereof, **is maintained continuously** different by 180° from the phase of the first half of the RF **excitation** Pulse waveform. ---

**Claim 8** --- The magnetic resonance imaging apparatus according to **claim 7**, wherein the RF irradiation control means performs such phase control for the RF differential coil that the phase **is an** inverse in two times of measurement, and the image formation means adds nuclear magnetic resonance signals obtained by **said** two times of the measurement **in order** to reconstruct one image. ---

**Claim 9** --- The magnetic resonance imaging apparatus according to **claim 1**, wherein the control means performs selective excitation **of** the slice direction upon excitation by application of **an** RF magnetic field.---

**Claim 10** --- The magnetic resonance imaging apparatus according to **claim 1**, wherein the control means performs selective excitation **of** the phase encoding direction or frequency encoding direction upon excitation by application of **an** RF magnetic field.--

**G) Insert claim 11 of the June 20, 2008 amendment and response:**

**Claim 11** --- The magnetic resonance imaging apparatus according to **claim 3**, wherein the multiple array RF transmitting coil is used also as an RF receiving coil of the RF receiving means. ---

**H) Replace claims 12 and 13 of the June 20, 2008 amendment and response with the following Examiner amended claims 12 and 13:**

**Claim 12** --- The magnetic resonance imaging apparatus according to **claim 11**, wherein the control means performs imaging with thinning out the phase encoding, and when an image is reconstructed by using nuclear magnetic resonance signals detected by each of the **RF excitation / reception** coils of the multiple array RF transmitting / **receiving** coil, the image formation means performs an anti-aliasing operation by using a sensitivity profile of each of the **RF excitation / reception** coils constituting the multiple array RF transmitting coil. ---

**Claim 13** --- The magnetic resonance imaging apparatus according to **claim 11**, wherein the image formation means composes images reconstructed by using nuclear magnetic resonance signals detected by each of the **RF excitation / reception** coils of the multiple array RF transmitting / **receiving coils in order** to produce one image. ---

**I) Insert New claim 14 of the June 20, 2008 amendment and response:**

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**Claim 14** ---The magnetic resonance imaging apparatus according to **claim 11**, wherein the RF excitation pulse is applied without a slice selection gradient magnetic field being applied simultaneously. ---

**F) Replace New claims 15 through 17 of the June 20, 2008 amendment and response with the following Examiner amended claims 15-17:**

**Claim 15** --- The magnetic resonance imaging apparatus according to **claim 1**, wherein said first **RF excitation** coil operates independently, and is decoupled, from said additional **RF excitation** coils. ---

**Claim 16** --- The magnetic resonance imaging apparatus according to **claim 1**, wherein said additional **RF excitation** coils are differential coils configured such that when the RF excitation pulse is simultaneously applied to each of said **RF excitation** first coil and said additional **RF excitation** coils, the phase of the first half of the waveform of an RF excitation output of said additional **RF excitation** coils is the same as a phase of a waveform of an RF excitation output of said first coil, and the phase of the second half of the waveform of the **RF excitation** output of said additional coils is **maintained to be held** different by  $180^{\circ}$  from the phase of the waveform of the **RF excitation** output of said RF excitation first coil. ---

**Claim 17** --- A magnetic resonance imaging apparatus **configured** for imaging a selected portion of a subject placed in a static magnetic, field, said magnetic resonance imaging apparatus comprising:

an RF transmission section configured to apply an RF excitation pulse through a **RF excitation** first coil and one or more additional **RF excitation** coils to said subject;

receiving means configured to detect nuclear magnetic resonance signals generated from the subject,

a control section configured to control an irradiation phase of the RF excitation pulse and control the RF transmission section and the RF receiving means, and

a signal processing section configured to reconstruct an image of said selected portion of the subject by using the nuclear magnetic resonance signals,

wherein the control section controls RF irradiation so that the RF excitation pulse is simultaneously applied to each of said **RF excitation** first coil and said one or more additional **RF excitation** coils, such that **within a single simultaneously applied RF excitation**, a phase of a second half of a waveform of an **RF excitation** output of at least one of said **RF excitation first coil** and said one or more additional **RF excitation** coils, after the temporal center of the **simultaneously applied** RF excitation pulse, is **maintained to be held** different by 180° from a phase of the first half of the **RF excitation output** waveform, such that **RF excitation** is selectively applied only to a local region **of the selected portion of the subject**. ---

The following is an examiner's statement of **Reasons for Allowance**:

4. With respect to **independent claims 1 and 17**: These claims are considered to be allowable over the prior art of record because the prior art of record neither discloses nor suggests an MRI apparatus/system configuration comprising the feature of “**within a single simultaneously applied RF excitation**, the phase of a second half of a waveform of an RF excitation output of at least one of said first **RF excitation** coil and said one or more additional **RF excitation** coils, after the temporal center of the **simultaneously applied** RF excitation pulse **is maintained to be held** different by 180° from the phase of the first half of the waveform **of the RF excitation output** such that the **RF excitation** is selectively applied only to a local region of the selected portion

of the subject" in combination, with each of the other features of the **independent claims 1 and 17** . It is the entire combination of the claim limitations set forth taken as a whole that constitutes both the novelty and non-obviousness of applicant's claims.

5. The invention of the instant application teaches away from what is known in the prior art, since the prior art does not alter the RF excitation waveform halfway through (i.e. act the temporal center of) the simultaneously applied excitation pulse supplied to a bunch of coils, including a first coil and at least one or more additional coils wherein the phase of the second half of the radio frequency excitation output waveform is different than the phase of the first half of the RF excitation waveform output for at least one or said first coil and said one or more additional RF excitation coils, such that the phase of the waveform is maintained to be held different continuously by 180° whereby the single simultaneously applied RF excitation is selectively applied only to a local region of a selected portion of a subject.

6. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

#### **Prior Art made of Record**

7. The **prior art made of record** and not relied upon is considered pertinent to applicant's disclosure.

A) **Pauly et al.**, US patent 5,150,053

B) **Vasanawala et al.**, US patent 6,307,368 issued October 23<sup>rd</sup> 2001.

#### **Examiners Comment**

##### ***Priority***

8. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

##### ***Drawings***



9. The examiner approves the drawing corrections to **figure 1**, which were submitted on **March 21st 2007**.

***Response to Arguments***

10. Applicant's arguments filed **June 20, 2008** have been fully considered but they moot in view of the amendments to the claims which have approved by applicant for entry by the examiner, as per the **September 19<sup>th</sup> telephonic interview**, and are set forth in the examiner's amendment herein. The examiner notes that the amended limitations clearly set forth the features of novelty argued by applicant in the June 20, 2008 amendment in response. Specifically, the amendments further clarify the fact that the applicant's invention takes place with respect to a single simultaneously applied RF excitation, as opposed to the applied prior art of **Pauly et al.**, which requires more than a single simultaneously applied RF excitation interval. Additionally the prior art of record, such as **Pauly et al.**, is directed towards controlling the waveform of the applied gradient magnetic fields as opposed to the waveform of the applied RF excitations. The amendments herein further clarify that the pulses addressed in applicant claims are RF excitation pulses and that the coils referred to are actually RF excitation coils, as opposed to gradient coils. The amendments herein also clarify that the phase shift which occurs after the temporal center of the RF excitation output waveform is maintained to be held continuously different by 180° in the first half of the RF excitation output waveform, which occurs before its temporal center, thus in applicant's invention. The second half of the wave form is consistently 180° out of phase with the first half of the RF excitation waveform, which also teaches away from what is known in the prior art of record.

11. Original specifications support for the examiner amendments filed here in is found within applicants' originally filed drawings and specifications. Specifically see figures 2b, 8a, 8b, and 8c, shows that with in a single simultaneously applied RF excitation pulse, the waveform phase of the RF excitation output after the temporal center thereof (i.e. the second half of the RF excitation waveform) is maintained to be held continuously 180° different in phase from the first half of the RF excitation waveform before the temporal center thereof. This feature is different than the prior art

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of record were the phase is simply inverted, because an inversion does not guarantee that the phase of the second half of the waveform is consistently 180° out of phase from the first half of the waveform as set forth by applicant in the amended independent claims set forth herein.

### ***Conclusion***

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tiffany Fetzner whose telephone number is: (571) 272-2241. The examiner can normally be reached on Monday, Wednesday, and Friday-Thursday from 7:00am to 2:10 pm., and on Tuesday and Thursday from 7:00am to 5:30pm.

13. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, **Diego Gutierrez**, can be reached at (571) 272-2245. The **only official fax phone number** for the organization where this application or proceeding is assigned is **(571) 273-8300**.

14. Information regarding the status of an application may be obtained from the Patent Application information Retrieval (PAIR) system Status information for published applications may be obtained from either Private PMR or Public PMR. Status information for unpublished applications is available through Private PMR only. For more information about the PMR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PMR system contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Diego Gutierrez/  
Supervisory Patent Examiner, Art Unit 2831

/TAF/  
October 7, 2008